DEFENSE NUCLEAR AGENCY

The Defense Nuclear Agency is seeking small businesses with a strong research and development capability and experience in nuclear weapon effects, phenomenology, operations and counterproliferation. (Note we are not interested in nuclear weapon design or manufacture.) DNA invites small businesses to send proposals to the following address:

Defense Nuclear Agency
ATTN: AM/SBIR
6801 Telegraph Road
Alexandria, VA 22310-3398

The proposals will be processed and distributed to the appropriate technical offices for evaluation. Questions concerning the administration of the SBIR program and proposal preparation should be directed to:

Defense Nuclear Agency
ATTN: AM/SADBU, Mr. Bill Burks
6801 Telegraph Road
Alexandria, VA 22310-3398
Tel: (703) 325-5021

DNA has identified 22 technical topics numbered DNA96-001 through DNA96-022. These are the only topics for which proposals will be accepted. The current topics and topic descriptions are included below. These topics were initiated by the DNA technical offices which manage the research and development in these areas. Several of the topics are intentionally broad to ensure any innovative idea which fits within DNA's mission may be submitted. Proposals do not need to cover all aspects of these broad topics. Questions concerning the topics should be submitted to:

Defense Nuclear Agency
ATTN: TAIC, Mr. David R. Lewis
6801 Telegraph Road
Alexandria, VA 22310-3398
Tel: (703) 325-1215

DNA selects proposals for funding based on the technical merit, criticality of the research, and the evaluation criteria contained in this solicitation document. As funding is limited, DNA reserves the right to select and fund only those proposals considered to be superior in overall technical quality and filling the most critical requirements. As a result, DNA may fund more than one proposal under a specific topic or it may fund no proposals in a topic area. Proposals which cover more than one DNA topic should only be submitted once.

DNA has not set aside funds for bridge funding. As such, proposers should not rely on bridge funding to cover the time gap between Phase I and Phase II.

DEFENSE NUCLEAR AGENCY
FY 1996 SBIR TOPIC INDEX

SURVIVABILITY AND HARDENING

SENSORS

COMMUNICATIONS NETWORKING

ENERGY STORAGE

ENVIRONMENTAL EFFECTS

ELECTRONIC DEVICES

NUCLEAR RELATED TECHNOLOGY

PROPULSION AND ENERGY CONVERSION

Subject Index for the DNA SBIR Solicitation

DEFENSE NUCLEAR AGENCY TOPICS

DNA 96-001 TITLE: Nuclear Weapon Effects Phenomenology

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Develop innovative algorithms to improve our understanding of nuclear weapon effects and the implementation of these algorithms.

DESCRIPTION: To improve the understanding of the impact of nuclear weapons under battlefield conditions, we require more accurate, efficient, user-friendly methods of calculating and displaying the affects of nuclear scenarios and their operational impact. Areas of interest include: improved accuracy even as calculational times are minimized; reliance on basic physical principles validated by measured test results; faster running calculations; and new and improved ways to enable users (be they advanced nuclear weapons effects researchers, weapon systems developers, or managers with limited nuclear weapons effects experience) to calculate, estimate, and appreciate nuclear weapon effects and their system impacts. Nuclear weapon effects include airblast; ground shock; water shock; cratering; thermal radiation; neutron, gamma and x-ray radiation; electromagnetic pulse; fallout; blueout; blackout; redout; and dust cloud formation.

Improved methods are required for the management of technical information that relates to the archival of nuclear weapon phenomenology and test data, as well as input to and retrieval of such data archives. Methods for developing unifying test data standards devised with application beyond just nuclear test effects are needed to improve data processing efficiency and reduce hardware and software specific requirements.

During Phase I, the research will demonstrate the feasibility of the proposed approach to improve the understanding of nuclear weapon effects or the archival and ease of use of stored data.

During Phase II, the research concepts developed in Phase I will be further developed and incorporated into appropriate codes.

COMMERCIAL POTENTIAL: Computer codes related to earthquake effects, pollution transport, signal propagation, data archival, and test standards for data.

REFERENCES: (1) DNA EM-1, Capabilities of Nuclear Weapons
(2) Glasstone, The Effects of Nuclear Weapons

DNA 96-002TITLE: Response of Materials and Structures to Nuclear and Conventional Weapon Effects

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Improve the survivability of weapon systems by using innovative materials and structure designs

DESCRIPTION: Of interest to DNA is understanding the response of materials, structures, and systems to nuclear weapons effects. Materials of interest include metals, ceramics and composites. New materials capable of being used as a structural members for aircraft, missiles, ships, submarines and military vehicles are of particular concern. New materials with enhanced electromagnetic shielding properties are also of interest.

Improved understanding of the failure mechanisms of structures is required. Potential utilization of underground test (UGT) tunnel response data to earthquake design criteria for underground structures. Type of structures include deep underground, land-based (fixed and mobile), sea-based (floating and submerged) and aerospace structures. Conventional as well as nuclear weapons effects are of interest. Improved methods are needed for analysis and model testing of structures to large deflection and collapse damage levels. Structures of interest include deep underground, land-based, sea-based, and aerospace structures.

During Phase I, the research will demonstrate the feasibility of the proposed designs/methodology to determine material or structural response to nuclear weapon effects.

During Phase II, the research concept developed in Phase I will be further developed where, if appropriate, the concepts will be incorporated into other existing methodology, codes, or structural designs.

COMMERCIAL POTENTIAL: Earthquake resistant buildings, underground facilities such as transportation and utility tunnels, and material and design improvements for structures, ships, aircraft, and vehicles.

REFERENCES: (1) DNA EM-1, Capabilities of Nuclear Weapons
(2) Glasstone, The Effects of Nuclear Weapons.

DNA 96-003 TITLE: Nuclear Weapon Effects on Electronics

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Explore the effects produced by nuclear radiation and electromagnetic pulse on electronics.

DESCRIPTION: The nature and magnitude of the effects produced by the interaction of nuclear-weapon produced radiation on electronics, electronic systems, opto-electrical devices, and sensors in the phenomenology areas of: a) Transient Radiation Effects on Electronics (TREE); b) Electromagnetic Pulse (EMP); c) System Generated EMP (SGEMP); and d) Source Region EMP (SREMP) are of interest to DNA. Particular areas of concern include: methods by which designers of space, strategic and tactical systems can assess their susceptibility to these effects; technologies to reduce the susceptibilities of electronic systems and devices (especially those with submicron feature sizes) to acceptable levels; and methods to demonstrate survivability under specified threat criteria. Concepts and techniques to model the nuclear radiation and electromagnetic system effects in the distributed interactive simulation (DIS) format are required. Concepts and techniques to improve the survivability (decrease the response) of systems against these nuclear weapons effects are required.

During Phase I, initial feasibility studies will be completed to demonstrate the viability of the proposed approach.

During Phase II, continue the investigation which was begun in Phase I to fully develop and demonstrate the proposed approach.

COMMERCIAL POTENTIAL: Commercial satellites and electromagnetic interference/compatibility.

REFERENCES: (1) DNA EM-1, Capabilities of Nuclear Weapons
(2) Glasstone, The Effects of Nuclear Weapons.

DNA 96-004 TITLE: Nuclear Weapon Effects on Communication, Sensor Operability, and Signal Propagation

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Investigate the effects of nuclear weapon explosion on electromagnetic and optical/signals, and the subsequent impact on the performance of communication and sensor systems.

DESCRIPTION: The Defense Nuclear Agency is interested in the basic physical processes which describe the interaction of nuclear weapons with the atmosphere, which create environments that degrade the propagation of communication and radar signals and that contain optical clutter backgrounds which degrade optical sensor systems. Part of DNA's mission is to predict effects on and determine mitigation methods for, DoD systems such as satellite communications, VLF/LF communications, HF/VHF/UHF communications, radar systems, and optical sensor systems. Areas of interest include mechanisms for the coupling of nuclear weapon energy to the atmosphere; the development of structure in weapon produced plasmas and molecular emitters; the chemical processes which give rise to the optical emissions; the transport and final deposition of nuclear debris; the effects of degraded signal propagation on the performance of communication systems and radars; and the prediction of the effects of optical

clutter backgrounds on the performance of optical sensor systems. Areas of interest also include the development of improved communications and sensor methods to mitigate atmospheric effects on systems and the development and application of simulators to test DoD systems in stressed environments.

During Phase I, demonstrate the feasibility of the proposed investigation to advance the understanding in any of the areas described above.

During Phase II, continue the investigation to develop a product or result that can be incorporated into the existing technology base.

COMMERCIAL POTENTIAL: Commercial communication systems and space sensors, and predictions of operational effects produced by solar events.

REFERENCES: (1) DNA EM-1, Capabilities of Nuclear Weapons
(2) Glasstone, The Effects of Nuclear Weapons.

DNA 96-005 TITLE: Nuclear Hardening and Survivability

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Develop innovative technologies to improve the nuclear hardening and survivability of DOD systems.

DESCRIPTION: Improved techniques for nuclear hardening and survivability of weapon systems, against nuclear weapons effects are required. These techniques should protect the system against the effects of blast, thermal, nuclear radiation, and electromagnetic pulse. In particular, the ability to harden communications facilities and surveillance sensors against electromagnetic pulse is of interest. Systems include planned and operational, strategic and tactical, ground mobile, missile, aircraft, and space systems and their subsystems and components.

During Phase I, demonstrate the feasibility and usefulness of the proposed technique.

During Phase II, fully develop the proposed technique and characterize its usefulness in both technical and cost terms.

COMMERCIAL POTENTIAL: Improved buildings, electronics, aircraft, satellites and better electromagnetic shielding.

REFERENCES: (1) Mil-Std-188-125
(2) Mil-Hdbk-423
(3) DNA EM-1, Capabilities of Nuclear Weapons
(4) Glasstone, The Effects of Nuclear Weapons

DNA 96-006 TITLE: Radiation Hardening of Microelectronics

CATEGORY: Exploratory Development, Electronic Devices

OBJECTIVE: Develop and demonstrate technology to: (1) radiation harden; (2) improve reliability and electrical performance; (3) improve radiation hardness and reliability assurance methods; and (4) characterize the radiation and reliability response of semiconductor devices (microelectronics and optoelectronics) including warm and cold operation metal oxide semiconductor (MOS), bipolar, and compound material technologies.

DESCRIPTION: The trend in semiconductor integrated circuits and sensors is toward increasingly higher levels of integration density, higher speeds, higher on-chip circuit complexity, lower voltage and power, and larger die size. All of these trends have exacerbated the problems associated with radiation hardening reliability, and testability. In addition, improvements in material science have lead to the introduction of a wide variety of compound

semiconductor materials into microelectronic and optoelectronic applications. The radiation and reliability responses of these materials is lacking or unknown.

Thus, it is the objective of this topic to develop and demonstrate innovative technology and methods to: (1) ensure that these devices can operate in a radiation or other stressing environment (e.g. very high or low temperatures); (2) improve device reliability; (3) improve producibility and yield; (4) develop cost-effective hardness and reliability assurance methods; (5) investigate and characterize the radiation response and reliability performance of these devices and associated materials; and (6) maintain device performance without degrading robustness. The development of technologies which enhance reliability, producibility, and yield will support the commercial semiconductor sector. In addition, the development of methods to improve the survivability of microelectronics in severe stressing environments is directly related to the commercial semiconductor and electronics industries.

During Phase I, the research will demonstrate the feasibility of the proposed technology and methods concepts.

During Phase II, the research concepts developed in Phase I will be demonstrated or reduced to engineering practice.

COMMERCIAL POTENTIAL: Robust microelectronics, satellites, high temperature sensors.

DNA 96-007 TITLE: Nuclear Weapon Effects Simulation Technology

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Improve the state-of-the-art in nuclear weapon effects simulation technologies.

DESCRIPTION: Simulators are needed to: provide experimental data for development of numerical simulations of nuclear weapons effects; simulate one or more nuclear weapons effects at laboratory size scale; and improve weapon system test capability. Simulation requirements include airblast over various surface conditions, dusty flow, dust lofting, shock propagation in rock, water shock, thermal radiation, EMP, and nuclear radiation.

Existing large scale simulators are often expensive and time consuming to operate, and require travel to an explosive test site. Small scale simulators are needed to provide extensive data to supplement the limited amount of data available from the large scale simulators. Innovative simulators are needed which are economical and simple to operate. Innovative ideas are needed on how to use very small scale simulators to produce useful information.

During Phase I, demonstrate the basic simulator concept.

During Phase II, demonstrate a laboratory scale simulator and produce useful data.

COMMERCIAL POTENTIAL: Numerical analysis; metrology; earthquake, hurricane, and tornado survivability.

REFERENCES: DASIAC-SR-92-0006, Guide to Nuclear Weapons Effects Simulation Facilities and Techniques - 1992 Edition

DNA 96-008 TITLE: Instrumentation

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Advance the state-of-the-art in nuclear and conventional weapon effects instrumentation.

DESCRIPTION: Instrumentation is used for measuring nuclear and conventional weapon effects including: phenomenology parameters and the response of test items exposed to conventional or simulated nuclear weapon effects. The instrumentation should be capable of operating under very harsh conditions, such as might be encountered in blast and shock tests, or tests involving high levels of x-ray, gamma, or neutron radiation. Instrumentation is needed for the following types of tests: airblast, ground shock, dusty flow, dust lofting, water shock, shock propagation in rock, High Explosive (HE), nuclear radiation (x-rays and gamma rays), thermal radiation, electromagnetic pulse (EMP) (high altitude or systems generated), and for improved data acquisition (transmission and recording). Desirable improvements include costs, ease of use, precision, accuracy, reliability, ease of calibration (preferably on site) and maintainability. Some current problems are the ability to make airblast and thermal measurements in an explosive debris environment, making explosive characterization measurements inside the high explosive itself during detonation, and do full characterization of debris (size and momentum) from encased explosive detonations.

During Phase I, build a prototype instrument or instrument system and demonstrate its performance in laboratory scale testing.

During Phase II, design, build, and test a full scale instrument system demonstrating its performance in its intended working environment. This may involve coordination with DNA to schedule testing in a simulator.

COMMERCIAL POTENTIAL: Metrology, Blasting Operations, Earthquake studies, radiation testing/monitoring, large structure (e.g., buildings, dams, and mines) integrity, fire protection, lightning protection, hazardous waste containment.

REFERENCES:
(1) DNA INWET Conference Announcement Brochure ,1993 and 1991
(2) Glasstone and Dolan, The Effects of Nuclear Weapons, 1977
(3) DNA EM-1, Capabilities of Nuclear Weapons (Classified)

(4) DASIAC-SR-92-0006, Guide to Nuclear Weapons Effects Simulation Facilities and techniques - 1992 Edition

DNA 96-009 TITLE: X-Ray Effect Simulation Technology

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Develop innovative technologies for the production of x-ray radiation.

DESCRIPTION: Future requirements for x-ray nuclear weapon effects testing will require vast improvements in existing radiation source capability as well as new concepts for producing soft x-rays (1-5 keV), warm x-rays (5-15 keV), and hot x-rays (>15 keV). Soft x-rays are used for optical and optical coatings effects testing. Warm x-rays are used for thermomechanical and thermostructural response testing; and hot x-rays are used for electronics effects testing. The proposer should be familiar with the present capability to produce x-rays for weapon effects testing.

Present Plasma Radiation Source (PRS) x-ray sources generate copious amounts of debris (material, atomic charged particles, sub-keV photons). Debris production is an even greater concern for the simulators currently under development. New measurement and analysis technologies are required to characterize the source and the debris generated from wire array and z-pinch PRS sources to better understand debris sources and mitigation. Existing debris shield technologies are not adequate to support larger exposure areas and cleaner test environments while minimizing fluence degradation. New methods, or combination of methods, need to be developed to stop, mitigate, and/or delay debris generated for radiation simulators.

New technologies to measure plasma parameters for simulator sub-systems such as plasma opening switches and plasma sources are of interest. Test response diagnostic technologies are required to measure the full time and spectral history of the radiation pulse across the breadth and width of the test asset as well as the response of the test asset during and after irradiation. Pulsed power diagnostic technologies are required for accurate, in-situ measurement of voltages and currents within the various simulator subsystems in order to monitor and characterize simulator performance. Diagnostic systems include required sensors/detectors, cabling, recording equipment and media, and, if necessary, computer systems and software.

During Phase I, demonstrate the feasibility of the proposed concept.

During Phase II, develop, test, and evaluate proof-of-principle hardware in its working environment on a radiation simulator. This will involve coordination with DNA to schedule testing in a aboveground test simulator.

COMMERCIAL POTENTIAL: Nuclear instrumentation, very fast closing valves and bright X-ray sources.

REFERENCES: DASIAC-SR-92-0006, Guide to Nuclear Weapons Effects Simulation Facilities and Techniques - 1992 Edition

DNA 96-010 TITLE: Distributed Interactive Simulation of Nuclear Weapons Effects

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Incorporate nuclear weapons effects and adapted nuclear effects technology into the Distributed Interactive Simulation (DIS) protocol

DESCRIPTION: Nuclear Survivability testing of new acquisitions and design modifications can be accomplished prior to "bending metal" through the use of the Distributed Interactive Simulation protocols and battlefield synthetic environment "testing". However, such assessments require validated systems models, nuclear environments and response algorithms; all capable of operating within the approved set of DIS protocol data units (PDUs).

Improved methods for nuclear environmental and effects representation within the DIS protocol are needed to calculate and assess such nuclear effects on systems (equipment and personnel) as prompt radiation (gamma, x-ray and neutron), protracted radiation, airblast, ground shock, water shock, cratering, thermal radiation, electromagnetic pulse, blackout and redout.

There have also been adaptations of nuclear effects technology to non-nuclear applications. Included are disaster planning tools for such natural disasters as hurricanes and earthquakes. Improved methods for representation of natural disaster damage and its impacts within the DIS protocol are needed to facilitate visual representation of the disaster and to train emergency managers/responders for appropriate responses.

During Phase I, the research will demonstrate the feasibility of the proposed approach to represent nuclear environments and effects in the DIS protocol.

During Phase II, the research concepts developed in Phase I will be further developed, tested, validated and submitted for inclusion into the IEEE PDU standards.

COMMERCIAL POTENTIAL: Emergency Management Training

DNA 96-011 TITLE: Nuclear Forces Security and Survivability Technologies

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Improved security and survivability of US nuclear forces.

DESCRIPTION: The possible possession of weapons of mass destruction (WMD) is of vital concern to prelaunch survivability (PLS) of nuclear forces. New and innovative concepts to improve PLS are needed to retain a viable nuclear strike capability and to enhance deterrence. The threats include enemy forces conducting unconventional, conventional, chemical and nuclear warfare during periods of peacetime, transition to war, and war. Long range program thrusts include peacetime and field storage, deceptive/OPSEC practices, nuclear force movements, and operational survivability of nuclear systems (aircraft and missiles). Concepts should employ innovative ideas and make use of new and emerging technologies. Work will include detector technology improvements and advanced algorithms for improved signal to noise ratio.

Measures to improve the security of nuclear weapons against all possible threats are required. Security measures include detection, assessment, delay and denial systems. Proposals should describe how they will improve protection against known and predicted threats and should emphasize weapon concealment where appropriate.

During Phase I, demonstrate the feasibility and potential usefulness of the proposed security or survivability technologies.

During Phase II, fully develop the proposed technologies so they can be compared to existing techniques.

COMMERCIAL POTENTIAL: Commercial Security Systems

DNA 96-012 TITLE: Operational Planning and Targeting Technology

CATEGORY: Exploratory Development, Communications Networking

OBJECTIVE: Improved ability of US nuclear commanders to plan for nuclear engagements and target nuclear weapons.

DESCRIPTION: The nuclear employment planning capabilities of operational commanders in tactical, strategic and integrated warfare environments require improvement. These improvements include development of automated planning systems; technologies to determine target damage objective and criteria; post strike target damage assessment capabilities; and automated nuclear weapon employment codes. Techniques to account for electromagnetic effects in operational planning and exercises are also desired.

During Phase I, develop the proposed technology in sufficient detail to demonstrate its feasibility.

During Phase II, continue the development of the proposed technology to the point it can be incorporated into existing planning/targeting methodologies.

COMMERCIAL POTENTIAL: Logistics planning, shipping route planning.

DNA 96-013 TITLE: Verification Technology Development

CATEGORY: Advanced Development, Sensors

OBJECTIVE: Improve/develop US technical capability to verify/monitor compliance with existing and potential future arms control treaties, agreements, and confidence and security building measures, e.g., START, INF, CW, CFE, NTT, SNF, CTBT, CCWC, Open Skys and Presidential Initiatives.

DESCRIPTION: New arms control measures are being negotiated. New verification technologies and methods will be required to accurately monitor compliance to the provisions of any treaties or agreements that could result from

the on-going negotiations or provide confidence building information. One problem will involve being able to distinguish between permitted activities and prohibited activities where the technical signatures between the two could be very minor. Another might include providing information to reduce tensions or intervene in crises.

During Phase I, demonstrate the feasibility of the proposed technology in relation to a potential arms control or confidence building application.

During Phase II, develop a proof of design to demonstrate the proposed technology.

COMMERCIAL POTENTIAL: Inventory Systems, Chemical Monitoring Systems

REFERENCES: Program Plan for Research, Development, Test and Evaluation for Arms Control Cooperative Inspection FY 93-95, OUSD(A), 4 Jan 93

DNA 96-014 TITLE: Counterproliferation Technology

CATEGORY: Exploratory Development, Sensors

OBJECTIVE: Develop new technologies for countering the proliferation of weapons of mass destruction.

DESCRIPTION: In support of the Department of Defense counterproliferation initiative, the Defense Nuclear Agency (DNA) is interested in identifying and integrating proven and maturing technologies to develop and demonstrate an operational capability to counter the proliferation of nuclear, biological, and/or chemical (NBC) weapons of mass destruction (WMD) located in a spectrum of facilities.

In Phase I, DNA is interested in initiatives in the following technical areas:

Hardened Target Defeat. Develop physical/functional lethality criteria for conventional weapons, including precision guided munitions, and advanced non-nuclear weapon payloads. Of particular interest are the development of shaft and portal vulnerability models. The models will be validated via weapon testing against simulated NBC targets.

Proliferation Path Analysis. Develop analytical models to predict the activities needed for development of NBC weapons programs by rogue nations. The model will alert DoD to potential proliferation activities and identify vulnerable chokepoints in the proliferation process for option development possible exploitation.

Enhanced Conventional Weapons Payloads Concepts. Develop concepts for the use of non-nuclear payloads delivered by penetrating weapons and released inside hardened NBC research/production/storage facilities to provide a significant increase in effectiveness (i.e. functional kill) over current conventional high explosive warheads. Of particular interest are payload concepts limiting the production of blast and high pressure gases, reducing collateral damage or nuclear/biological/chemical agent dispersal.

Collateral Effects Prediction Technology. Develop technology to define and predict weapon and target environments that cause unintended casualties. Of particular interest are improved atmospheric transport and dispersal models to provide significantly improved meteorological predictions along with embedded source term and transport models. The effort will also provide validated models to rapidly assess the effects of a strike on a NBC facility. End product will be a deployable collateral effects assessment capability for planners, decision makers, and users.

Targeting Technical Assistance. Develop technology to assist the theater user in conducting pre-attack weaponeering (including collateral effects prediction/mitigation) and post-attack battle damage assessment. Areas of emphasis include development of tools for proliferation path analysis, target planning, and collateral effects prediction/mitigation. End product will be a deployable expert system for operational planners using analytic prediction tools, multimedia hypertext databases, and technical manuals in concert with applied research, with possible sensor data use for condition updates.

Target Signature Evaluation. Develop sensor technology and analytical procedures for NBC target pre-attack characterization by understanding the operational aspects of target facility missions, architecture, prime mission equipment, critical subsystems, and functional vulnerabilities. The sensors must also provide data on weapon performance and reliable battle damage assessment. Of particular interest are air-dropped or man-emplaced unattended ground sensors, including hyper-spectral, seismic, thermal, electromagnetic, acoustic, gravimetric, and chemical.

Agent Neutralization. Provide a basic understanding of chemical and biological weapons response to weapons environments. Specifically, provide data and models describing the neutralization of threat agents to thermal, shock, and ionizing radiation environments. In addition, define the collateral effects source terms (quantity of agent released in viable form) of downed hostile cruise missiles carrying biological agent payloads.

Counterproliferation Advanced Concept Technology Demonstration (ACTD). Develop basic research to complete the development of codes and analytical models for weather, collateral effects, target/weapon interaction described above.

In Phase II, develop promising technologies to be used.

In Phase III, will be inclusion to the end-to-end ACTD to be conducted. The ACTD will feature pre-attack site characterization using sensors and analytic tools. High-fidelity targets (simulating hardened WMD targets) will be attacked using a variety of advanced conventional payloads to evaluate penetration, lethality, and collateral effects. Sensors will also be used to determine weapon performance and battle damage assessment.

COMMERCIAL POTENTIAL: Characterization and warning sensor technology. Software decision and tracking models. Environmental modeling. Structural Dynamics predictive tools.

REFERENCES:
(1) Presidential Decision Directive/NSC-13 (Classified Subject).
(2) SECDEF Remarks to the National Academy of Sciences Committee on International Security and Arms Control, 7 Dec 1993 ("The Five Dangers").
(3) Deutch, Report on Nonproliferation and Counterproliferation Activities and Programs, May 1994.
(4) 1992 Defense Science Board Summer Study on Technical Military Capabilities for Future Contingencies: Countering Weapons of Mass Destruction in Contingency Operations, March 1993

DNA 96-015 TITLE: Pulsed Power Technology and Applications

CATEGORY: Exploratory Development, Energy Storage

OBJECTIVE: Dramatic improvements in energy storage, switching, and power conditioning technologies.

DESCRIPTION: Future requirements for systems employing pulsed power will necessitate improvements in efficiency, energy density, reliability, repeatability and overall performance over the existing state-of-the-art. Innovative approaches for component or subsystem development are sought to meet future demands for radiation simulators and other pulsed power applications. Examples include more efficient pulse forming technologies, high energy density capacitors, more efficient insulators, improved and more reliable switching technologies, and improved power flow electrical circuit models. Pulsed power applications include operation at kilovolts to megavolts, kiloamperes to megaamperes, and repetition rates from single pulse to 10 kilohertz. New diagnostics used to enhance the operation of the various pulsed power elements are required.

Recent advances in energy storage and switching technologies now make possible the application of DNA pulsed power technology to such areas as armor/anti-armor; electromagnetic/electrothermal guns; mine-countermine; air, surface, and subsurface systems; high power microwave weapons; etc. Concepts for new applications of pulsed power should be highly innovative and make full use of the emerging pulse power technology.

During Phase I, demonstrate the feasibility of the proposed concept.
During Phase II, develop, test,and evaluate proof-of-principle hardware.

COMMERCIAL POTENTIAL: Compact power devices to clean up smoke stack effluents and environmental pollution control, metal cutting and electric vehicles.

REFERENCES: (1) Pulsed Power Symposium
(2) EML Symposium

DNA 96-016 TITLE: Directed Energy Effects

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Investigate the effects of directed energy and develop survivability technologies to mitigate these effects.

DESCRIPTION: The effects of directed energy sources such as lasers, neutral particle beams and charged particle beams on materials, structures and systems are of interest to DNA. Of particular interest are the establishment of the correlation between nuclear weapons effects and directed energy effects, the identification of materials which are capable of withstanding both nuclear weapons effects and directed energy effects, and the interaction mechanisms of directed energy sources actually interact with target materials/structures.

During Phase I, demonstrate the feasibility of the proposed investigation.
During Phase II, characterize the effects of directed energy on materials, structures, etc.

COMMERCIAL POTENTIAL: High energy welding.

DNA 96-017 TITLE: Forecasting Environments in the Troposphere and Space(FORETS)

CATEGORY: Exploratory Development, Environment Effects

OBJECTIVE: To investigate the effects of the natural and disturbed environments on atmospheric and space forecasting methods. Develop techniques to mitigate these effects, account for physical processes contributing to chaotic environments, and improve performance predictions.

DESCRIPTION: The Defense Nuclear Agency (DNA) is interested in the basic physical process which describes the effects of the natural and disturbed environment on the employment of various weapon systems. These environments may create situations that degrade the propagation of communication and radar signals, optical sensor systems, and weapon system employment. Part of DNA's mission is to predict effects the environment will have on these systems. Areas of interest include development of models and model predictions to forecast the effects of clouds on the theater of operations; the identification and streamlining of a model for support of theater operation; the development of a coupled space weather model to predict particle fluences and spectra; and the development of cloud and scintillation climatologies.

During Phase I, demonstrate the feasibility of the proposed areas of investigation to advance the understanding in any one of the areas.

During Phase II, continue the investigation leading to the development of models/products that can be incorporated into the existing technology base.

COMMERCIAL POTENTIAL: Weather prediction.

REFERENCES: (1) Journal of Atmospheric Sciences
(2) Journal of Geophysical Review
(3) Radio Science

(4) Weather Review

DNA 96-018 TITLE: Advanced Lethality Technologies

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Demonstrate innovative applications of advanced non-nuclear technologies for enhanced target lethality or nuclear effects simulations.

DESCRIPTION: Of interest to DNA is the development and demonstration of capabilities which may significantly extend weapons range-to-effect or enhance lethality against hard targets. The response of a hardened bunker complex or of intrinsically hard ballistic missile sub-munition warhead payloads are of particular interest. Novel applications of explosives technology, hyperkinetic technologies, or directed energy (DE) concepts will be of interest.

During Phase I the research will develop concept feasibility through either analysis or laboratory scale demonstration.

During Phase II, the concepts will be further developed through more definitive experiments and/or sophisticated computational analyses.

COMMERCIAL POTENTIAL: Hypervelocity, advanced explosives.

DNA 96-019 TITLE: Field Expedient Hardening

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Develop innovative methods that would temporarily harden military and civilian equipment to nuclear weapon effects.

DESCRIPTION: Innovative methods to temporarily harden military and essential civilian equipment to the effects of nuclear weapons are of interest. Installation should be relatively easy and quick (hours to a few days) and provide protection for several months to a year. Such hardening methods must be practical for field equipment and allow operation of the system.

During Phase I the research will develop concept feasibility through either analysis or laboratory scale demonstration.

During Phase II, the concepts will be further developed through more definitive experiments and/or field demonstrations.

COMMERCIAL POTENTIAL: Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC) protection, lightning protection.

REFERENCES:
(1) Mil-Std-188-125
(2) Mil-Hdbk-423
(3) DNA EM-1, Capabilities of Nuclear Weapons
(4) Glasstone, The Effects of Nuclear Weapons

DNA 96-020 TITLE: Fault Detection, Packaging and Testing

CATEGORY: Exploratory Development, Survivability and Hardening

OBJECTIVE: Improve the testing capability which stress operation or functional testing of densely packed systems and subsystems.

DESCRIPTION: The ability to test densely packaged systems and subsystems requires the development of new test vectors and a new screening process prior to testing at a radiation test facility. The objective of this topic is to develop and demonstrate innovative software and hardware that will: 1) ensure worst case stressing while testing in radiation or other hostile environments; 2) improve the fault detection with location of fault; 3) improve exercising software; and 4) improve low noise testing for high upset package parts in multichip modules or high density packaged circuits.

During Phase I the research will develop the feasibility of the proposed technology, methods, and concepts.

During Phase II, the research concepts developed in Phase I will be demonstrated or reduced to engineering practices.

COMMERCIAL POTENTIAL: Satellites, Information Highway.

DNA 96-021 TITLE: Advanced Space Nuclear Power and Propulsion Technology

CATEGORY: Exploratory Development, Propulsion and Energy Conversion

OBJECTIVE: Demonstrate innovative approaches to space power and propulsion technologies that use space nuclear reactors as the power source. Nuclear fuel technology is excluded from this effort.

DESCRIPTION: The Defense Nuclear Agency (DNA) is interested in the development and demonstration of capabilities that extend the maturity of the U.S. space nuclear power and propulsion technology base. Technologies supporting power-only, propulsion-only, and
bi-modal (power+propulsion) are of interest. Particular interest for power technologies is in static conversion processes. System level research is not included in this effort, nor is nuclear fuel technology.

During Phase I, the research will develop material, component, or subcomponent feasibility through analysis or laboratory scale demonstrations.

During Phase II, material, component or subcomponent will be further developed through more definitive experiments, analysis and/or life testing.

COMMERCIAL POTENTIAL: Supports high-powered (>10 kWe) satellites, Space-Tug concepts, Launch Vehicle Step-downs for massive satellites.

DNA 96-022 TITLE: Nuclear Weapon System Safety Assessments

CATEGORY: Exploratory Development, Nuclear Related Technologies

OBJECTIVE: Improved safety of US nuclear weapons

DESCRIPTION: Quantifying, reducing, and managing the risks associated with the life-cycle management of US nuclear weapons is of vital importance. New and innovative concepts to improve on traditional probabilistic risk assessment techniques and methodologies, as well as operations are desired to increase the overall safety of these assets. Abnormal environments that may be encountered include mechanical insults (e.g., drops, vehicle accidents), thermal insults (e.g., fuel fires), electrical insults (e.g., lightning, electrical power), and combinations of these environments. Long range program thrusts include characterizing these abnormal environments, analyzing human factors and developing quick running models to allow decision makers to manage safety risks. Concepts should employ innovative ideas and make use of new and emerging technologies. Work will include measurement improvements, risk reduction techniques, and advanced algorithms for improved quick-look capabilities.

Measures to improve the safety of nuclear weapons against all possible abnormal environments are required. Safety enhancement measures include prediction of events through characterization of initiators and eliminating/mitigating such initiators. Proposals should describe how they will improve protection against known and predicted risks and should emphasize risk elimination/reduction where appropriate.

During Phase I, demonstrate the feasibility and potential usefulness of the proposed safety technologies/techniques.

During Phase II, fully develop the proposed technologies/techniques so they can be compared to existing techniques.

COMMERCIAL POTENTIAL: Data risk assessment and management models potential for adaptation to a variety of users. Risk models can be used in evaluating manufacturing alternatives, optimizing safety budgets and equipment, to reducing risks in the home or comparing potential alternate decisions.

REFERENCES: (1) Joint DoD/DOE Surety Plan, August 1991
(2) Report of the Panel on Nuclear Weapons Safety, December 1990